

Road maintenance, road decommissioning, and stream crossing upgrades

Estimating Costs of Road Decommissions

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ABSTRACT

Road decommissioning has become one of the more common and beneficial restoration treatments applied to forested watersheds. Decommissions can look substantially different from watershed-to-watershed as a result of differences in land-forms, conditions and local issues, as well as differences between practitioners and treatment approaches. Costs for decommissions can vary widely as well as a result of these differences. Cost estimates for decommissioning can be developed at any scale, but for high confidence in the estimates, on-the-ground surveys are essential.

INTRODUCTION

This paper summarizes the methods used for developing and refining cost estimates for road decommissions on the Mt. Adams Ranger District of the Gifford Pinchot National Forest. It describes some of the key information needs associated with developing cost estimates, identifies some of the reasons costs may vary between decommission projects, and identifies some of the issues that may be encountered when estimating decommission costs at larger scales. The basis for this paper is work that has been conducted on the Mt. Adams District over the past several years, during which time over 100 miles of road have been decommissioned. The paper is organized by major headings that were suggested by the National Marine Fisheries Service (NMFS) for this presentation. It begins with a brief synopsis of what is entailed in road decommissioning on the Mt. Adams District.

WORKING DEFINITION OF ROAD DECOMMISSIONING

There are many different interpretations of the term “road decommissioning.” To some it means closing a road, walking away from it, and taking it off the road inventory. To others it implies full recontouring of the hillslope where the road was constructed. On the Mt. Adams Ranger District, our intent in decommissioning a road is to remove the drainage structures that reroute hillslope drainage and that present slope stability hazards. This requires removal of culverts, eliminating the need for roadside ditches, and removal of fill material from stream channels and

from unstable locations. In addition, the road surface is scarified to improve infiltration, promote the establishment of vegetation, and to reduce overland water flows. A typical road decommission on our District would include the following work items:

- Remove all culverts and associated fill
- Reshape and stabilize stream crossings
- Scarify the road bed and compacted areas
- Waterbar the road bed
- Excavate and stabilize unstable fills
- Revegetate the road surface, crossings, and disturbed areas
- Install and implement a road closure — both physical and legal

In essence, all culverts and associated fill material are removed from stream crossings, swales, and at ditch relief culverts. After removing the fill and culverts, excavated slopes are shaped back to a stable angle, generally attempting to mimic the slope of adjacent undisturbed slopes. In some cases, structural elements are added to the excavated stream bottom (rocks, woody debris, etc.) to improve stability and add diversity to the channel. The entire road surface is then scarified or decompacted (using an excavator) to encourage water infiltration and re-establish vegetation on the road surface.

Waterbars are constructed on the scarified roadbed to drain any surface water that does accumulate on the road surface. Where fill slopes appear unstable, are cracking, or where there have been failures in the past, fill material is excavated and placed against the cut slope of the road or hauled to a more stable location. The road is then revegetated with local native grasses, tree seedlings are planted at stream crossings, and a physical closure is constructed at the entrance to the road. The closure usually includes a large berm backed up by a ditch to prevent vehicles from driving over it. Finally, we put a

legal closure on a road, because many people will still try to drive on it. The legal closure is important because it allows our law enforcement officer to enforce the closure.

INITIAL COST APPROXIMATION

Information Requirements

The following list includes informational items we have found to be necessary in developing initial cost estimates:

- Land ownership
- Location of project relative to equipment and labor
- Length of road to be decommissioned
- Number of segments and proximity to one another
- Number of stream crossings
- Depth of fill at all culverts
- Type of road construction
- Geology/landform stability/past failures from road system
- Cost of past decommissions in the area

Identifying major land ownership lines is simple, and can be helpful in estimating costs. For example, if the project is on National Forest lands—and particularly in areas managed under the Northwest Forest Plan—the level of pre-project surveys and environmental documentation is quite high relative to other areas. The Northwest Forest Plan requires that prior to any ground disturbing activity, surveys must be undertaken for amphibians, mollusks, fungi, lichens, and other organisms. This takes time, can only be done during certain seasonal time windows, and can be quite expensive. In addition to Forest Plan requirements, consultation with regulatory agencies including the U.S. Fish and Wildlife Service, NMFS, and State agencies also takes time and therefore has associated costs.

Secondly, the location of the project relative to equipment and labor must be consid-

ered. Bringing heavy equipment and operators hundreds of miles to a project site adds to the cost. Similarly, if there are several segments of road to decommission, are they in close proximity or will the equipment need to be transported a considerable distance from segment to segment? Each time the equipment is loaded onto a trailer for transporting, costs go up.

Culverts are typically the primary expense in road decommissioning because it takes quite a bit of time to excavate the culvert and fill material, and to shape the slopes of the excavation. Identifying the number of culverts involved in the project and how deep they are beneath the road surface is key to developing cost estimates. Costs for culvert removal can go up almost exponentially with deeper culverts, because so much more fill removal is required, and because access to deep culverts is difficult. In addition, when large amounts of fill need to be removed, there is often no room to place the material nearby, so it must be end-hauled to another location. Hauling of fill material can significantly affect project costs.

Knowledge of the topography and geology of the area, and of road construction techniques is essential. In particular, having some information on landform stability and, if possible, a record of past failures on the particular road system can

be important indicators of how much of the road will need to be recontoured for stability. In areas with unstable slopes, or steep slopes where cut and fill road construction methods have been used, costs can be increased dramatically to stabilize and/or remove road fills. In addition, with road systems that have a long history of failures, there may be additional costs in acquiring access to the entire road (i.e. in some cases, partial repairs of a road are required just to allow access to other unstable sites and culverts further out on the road system). On-the-ground knowledge is particularly important here.

Availability of accurate information about the unit cost of past decommissions in the area can be most valuable when developing cost estimates. This information, especially when correlated with accurate topographic data, road locations and landform characteristics can go along way toward developing reasonably good first approximations of cost. For example, Table 1 provides an array of costs we've encountered on past road decommission projects

By itself, this table can be helpful to a planner for providing some context on the range of past decommission costs in the area. When combined with a topographic map that depicts the locations of these past decommissions, the data becomes even more useful. In

Table 1. Example project costs and unit costs for six road decommissions

Project Name	Muddy Cost (\$)	Clrwtr Cost (\$)	Wind Cost (\$)	Dry Cost (\$)	Trout Cost (\$)	Curly Cost (\$)
Treated Road Lengths (km)	7.05	3.75	18.57	10.35	14.24	21.3
Total Project Cost (\$)	105,681	33,565	49,926	73,682	26,052	75,712
Per Unit Cost (\$/km)	14,990	8,951	2,688	7,119	1,829	3,555

this case, the map would show that the higher cost decommissions all occurred on steeper, more incised hillslopes. The lower cost decommissions were located on gentle slopes, valley bottoms, or ridgetops. There are many other variables that go into the ultimate cost of the decommission, but in this case much of the variability in cost can be indexed by the slope angle and degree of dissection in the landscape where the decommissions occurred.

Methods for Estimating Cost

Publications are available that can help estimate decommissioning costs. The Forest Service *Engineering Cost Guide* provides costs to government for labor and equipment. The edition we use covers all of the National Forests in western Washington, and provides costs for a range of laborer and equipment types. Each forest or region has a similar required guide, and these rates are enforced; e.g., contractors working for the Federal government must pay employees at the stated wage rates in the guide. This holds true with cost-share projects on private land that are funded with Federal dollars as well.

An *Equipment Performance Handbook* provides specifications for the kind of production and performance to expect out of a particular piece of equipment. For example, this handbook describes how long it would take a particular piece of equipment to accomplish a given amount of work. Combining the estimates in this book with the cost information provided in the *Engineering Cost Guide* can give a reasonable estimate of the cost for various decommission work items. Reviewing the cost of past projects provides another means of checking that cost estimates are reasonable.

In estimating material costs, it is important to know what the local issues are. For example, on our District, we strive to use locally-derived native species for revegetation. The cost of acquiring the necessary

amounts of seed for this type of treatment are quite high, and in some cases can rival the cost of contracted heavy equipment work. Other areas may not require native or local grass seed, or may have better sources of that material, so costs can be significantly lower. It is important to discover what the local issues are, and what requirements will be placed on the project by regulatory agencies before choosing materials and before developing a cost estimate.

REFINING INITIAL COST ESTIMATES

Estimation Methods

The following list identifies some of the information that is helpful in refining initial cost estimates:

- Field reconnaissance of roads:
 - Accurate road length
 - Count of pipes, including depth, size
 - Types of crossings (e.g., stream class)
 - Identify unforeseen conditions (road failures, impassible bridges, etc.)
 - Locate and recon unmapped roads
 - Identify/quantify road stability issues
 - Identify soil types, road surfacing
 - Identify road grades
 - Identify fill placement sites if necessary
- Distance to culvert disposal/recycling
- Knowledge of local issues (fish/botany/wildlife/recreation/access)

We walk or drive the entire length of every road proposed for decommissioning to get an accurate road length and to identify conditions on the road that will affect the cost and implementation of the decommission. Roads shown on U.S. Geological Survey (USGS) maps and U.S. Forest Service (USFS) maps are often inaccurate in terms of the length, the location, and sometimes even the existence of the road. Through field surveys, we've identified numerous roads that weren't mapped; we've

also field checked mapped roads and found them to have been previously decommissioned, or that they are entirely covered with vegetation and not even recognizable as a road anymore. Unmapped spur roads off of roads planned for decommissioning must be evaluated and treated during the project, because once the decommission has occurred, they will be inaccessible for road maintenance, drainage repair, or for subsequent decommissioning.

In some cases, a road identified for decommissioning will be inaccessible or partially blocked by a fill failure or culvert washout on the road. Field visits of all candidate roads will allow the project designer to identify this type of access difficulty and to build the cost of dealing with it into the cost estimate and the design. These situations are not unusual since many of the roads to be decommissioned are unneeded roads that have not been well-maintained in the past.

During field surveys, all culverts and crossings are documented and evaluated. Culvert sizes, depths of fill, type and condition of bridge materials, as well as the types of stream encountered can all affect the decommission design, the equipment necessary to implement the treatment, and ultimately the cost of the project.

Field surveys are also essential for identification of road and slope stability concerns. Where road fills are cracked, show evidence of past movement, or have failed, special design considerations must be built into the cost estimate. These areas, and the treatments designed for them can significantly affect the types of equipment needed, the time involved in the decommission, and the unit costs. In situations where substantial amounts of fill need to be removed, identification of fill placement sites may be necessary. On narrow forest roads it is often difficult to find disposal sites nearby. Long distance end-hauling of

fill material can dramatically affect decommission costs.

Our contractors are required to remove all culverts from National Forest lands after they've been excavated. Although we don't pay for the hauling of culverts as a direct bid item, the contractor must cover these costs somewhere in the bid, and the costs for hauling and for disposing or recycling the culverts must be accounted for in the cost estimate.

Local issues can affect where and how you decommission, and ultimately the cost of the decommission. Some of the factors to consider include: location of the project relative to habitat for threatened and endangered species or municipal watersheds, land ownership, mitigations required by State and Federal agencies, degree of road access that must be maintained during and after the project.

Changes in Unit Cost with Increasing Scale

Larger projects may yield some economies of scale, though on our District we have not had experience with this. Some of the areas where economies may be realized include: reduced mobilization costs, better prices on erosion control materials including grass seed and straw mulch, less overhead associated with contract development and advertising, and more efficient environmental documentation (i.e. doing one Environmental Assessment instead of several). Also, once an operator has been working in an area under a particular set of guidelines, he can often find more efficient ways of accomplishing the work, and can improve his cost estimates for subsequent work. Probably the most important gain in having one large contract as opposed to several smaller contracts is the increased consistency in the work, and the potential for less oversight being required once the operator has a clear picture of what is desired.

ESTIMATING COSTS AT LARGE GEOGRAPHIC SCALE

Information Requirements

Generally, the same type of information is needed regardless of scale. As previously mentioned, having information on the cost of past decommissions can be invaluable for estimating costs. But the estimator should be sure to look at both the *average* of past costs, and the full *range* of costs experienced. Localized or site-scale issues associated with a particular road can cause the cost to vary widely from average costs of past decommissions. In addition, the state of the local economy and job markets can significantly affect the demand for this kind of work, and thus the amount a contractor will bid.

Availability of Data Sources

Topographic maps from the USGS and USFS are readily available and can be used as a rough indicator of stream crossing frequency and slope gradients—both helpful for estimating costs of decommissions. Quality of these maps is good for topographic data, but probably is only low-to-moderate for roads. Local Geographic Information Systems (GIS) are typically a better source for getting initial road locations and lengths, but even the GIS layers can have a wide range of accuracy. Information on slope stability can be found in USFS GIS mapping, or from State level maps that can be acquired through State Department of Natural Resources. Maps of any type however, will not replace on-the-ground surveys for developing accurate cost estimates consistently.

Confidence in Cost Estimates for Large Scale Projects

Confidence in estimating costs is dependent upon the level and quality of data available. At large scales, the readily available

data (if no field work is done) is probably not of high enough resolution or quality to provide high confidence in the cost estimates. However, if information is available on the cost of past decommissions in an area, reasonable estimates of the range of expected costs can be developed even without good on-the-ground surveys. With information on the cost and location of past decommissions and on-the-ground data from field surveys of target road systems, cost estimates for large scale projects could be developed with high confidence.

CONCLUSION

Cost estimates for road decommissions can be developed at any scale. Data most critical to developing accurate cost estimates include the length of road, number of stream crossings, depth of fill at crossings, and relative stability of landforms and roads in the area. In the absence of field surveys to assess this information, readily available data (USGS maps, USFS databases, etc.) are probably not detailed enough to provide for high confidence in cost estimates at any scale. However, cost information from past road decommissions in a particular area can be used in conjunction with available road and landform data to develop reasonably good first approximations of cost both at smaller and larger scales. Higher confidence levels can be achieved only through field surveys of road systems proposed for decommissioning. Economies of scale may occur with larger projects, but savings are not expected to be particularly significant. A more likely benefit of larger-scale projects would be the potential for improving the quality and consistency of the projects by working with the same operator(s) on a large number of decommissions.

